EFFECT OF STIMULI ASSOCIATED WITH THE MALE ON LITTER SIZE IN MICE*

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Introduction

The oestrous cycle in the mouse lasts about 4 days so that in a population of sexually mature females one expects about one-quarter of them to be on heat every night. When single female laboratory mice that have been reared together with other females are placed with one vigorous male in a clean container, the oestrous cycle is affected in many of them. Oestrous is delayed in some and hastened in others with the result that fewer than expected copulate on the first, second, and fourth day, and more than expected copulate on the third day (Whitten 1956). This phenomenon has been called the Whitten effect (Nalbandov 1964). Whitten's data were records of copulations as judged by presence of vaginal plugs.

Data are presented here which show that, as well as the Whitten effect on the length of the oestrous cycle, introduction of a male affects the number of ova shed by a female mouse, as judged by the number of live young produced at birth.

Stock and Methods of Husbandry

Data were obtained from generations 0–7 of a colony of albino laboratory mice being propagated at the Department of Animal Husbandry, University of Melbourne, by 100 or more pairs of mice per generation. The first four generations were unselected. For the subsequent four generations the colony was divided into several selection and control populations.

Generation 0 consisted of 20 males and 79 females obtained from the Division of Animal Health, CSIRO, Parkville. The CSIRO colony is propagated, without conscious selection, by at least 40 males and 160 females per generation. Thus these mice should not be inbred to any great extent.

The mice were kept in plastic dishes 12 in. in diameter, covered by wire mesh, and held in racks. At 3 weeks of age the mice were sexed and reared, 6–8 of the same sex per dish, to about 12 weeks of age when they were mated.

Clean dishes were provided for all matings and, after generation 0, the mice were mated, one male and one female per dish. In generation 0 each male was placed with four females. Males remained with the females for 16 or 17 days before being removed. The number of live young born was recorded on the morning on which the litter was found. These records provided the data for the analysis given in this paper.

Results

Table 1 shows the number of females that had a litter 19 or 20, 21, 22, 23, and 24 or more days after being put with a male. The data confirm the Whitten effect. The effect also occurred in generation 0 when females were in groups of four at mating.

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Table 2 shows the average number of live young per litter born 19 or 20, 21, 22, 23, and 24 or more days, respectively, after introduction of a male. The number of litters represented in each average is, of course, the number of mice shown in the corresponding place in Table 1.

TABLE 1

NUMBER OF FEMALES PRODUCING LITTERS AT VARIOUS TIMES AFTER INTRODUCTION OF MALE

Generation	No. of Females Mated	No. of Females Producing Litters on: Day 19, 20*	Day 21	Day 22	Day 23	Day 24 or Later
0	79	10	11	27	13	13
1	100	18	9	29	21	18
2	100	11	15	46	11	15
3	100	10	13	29	27	17
4	140	9	17	55	28	24
5	140	22	16	58	27	8
6	140	20	16	49	23	23
7	140	25	28	36	16	26
Total	939	125	125	329	166	144

* Six of these littered on day 19.

As a consequence of the Whitten effect there were unequal numbers of litters involved on the different days. An appropriate method of analysis, therefore, was as follows: The underlying variance in litter size for each day of birth in each generation was found and pooled. This variance divided by the harmonic mean number of litters on each day of birth in each generation was then used as the error variance for an analysis of the means given in Table 2. Table 3 gives the resulting analysis of variance. There was no evidence of interaction between

TABLE 2

AVERAGE NUMBER OF LIVE YOUNG PER LITTER BORN AT VARIOUS TIMES AFTER INTRODUCTION OF MALE

Generation	Average No. of Live Young per Litter Born on: Day 19, 20	Day 21	Day 22	Day 23	Day 24 or Later
0	10·40	11·00	10·74	10·00	9·23
1	10·17	9·89	9·90	9·71	9·28
2	9·27	10·07	11·17	9·45	9·47
3	8·50	8·85	9·10	8·59	8·71
4	11·56	8·53	10·15	9·57	9·79
5	9·32	10·25	10·55	9·22	10·37
6	9·45	10·06	10·20	9·70	9·13
7	9·32	9·39	10·64	9·44	9·31
Unweighted mean:	9·75	9·76	10·31	9·46	9·41

generation and day, in mean litter size. However, the effect of day of birth (like that of generation) was highly significant. Table 2 shows that on day 22 average litter size was 0·55–0·90 units greater than on the other days. The number of young found dead at birth was less than 1% of all young born. There was no indication that this number varied between days of birth.

TABLE 3

ANALYSIS OF VARIANCE OF MEAN LITTER SIZE ON THE VARIOUS DAYS IN EACH GENERATION

Source of Variation	Degrees of Freedom	Mean Square
Generations	7	0·9840**
Days	4	1·0147**
Interaction	28	0·3355
Error	849	0·2596

** $P < 0 \cdot 01$.

Discussion

Nalbandov (1964) suggested that a study of animal behaviour as it affects reproduction would be profitable, and cited several cases of alterations to reproductive sequences. In mice there is another important phenomenon that was first reported by Bruce (1959). Bruce showed that introduction of strange males to recently mated females suppressed pregnancy in some of these females, leading to a mating with the new male.

The effect on litter size described in this paper appears to be less of an alteration to normal reproduction than either the Whitten effect or the Bruce effect. This may, however, be a consequence of the method of measurement, the counting of live young at birth. It is possible that the effect on number of ova shed is much greater, with uterine conditions imposing a limit on the number of foetuses that can be carried to term.

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